A. (12 marks)

Say whether each of the following statements is true ("T") or false ("F").

XT In the context of UNIX, a program is (the same as) a process.

VF In the context of UNIX, one parent (process) only has one child (process).

XT An environment variable is a shell variable whose name begins with a '$' character, as in "`$PATH`".

VT A `for`-loop in C has the form

```
for ( expr1; expr2; expr3 )
    statement
```

If all three expressions are present, then this is equivalent to

```
expr1;
while ( expr2 ) {
    statement
    expr3;
}
```

Note: whether this statement is true or false has nothing to do with whether or not a semicolon follows *statement*. The definition of a *statement* includes the case where it needs a terminating semicolon.

VT In C, a function can return values of type `int`, `char`, and `float`, among others.

VT 4.3BSD was an early version of UNIX which had major impact on the eventual evolution of UNIX.

VT One type of file in UNIX is a directory.

VF To have a command execute as a background process, a '^Z' character is appended to the end of the command.

VT The bit pattern

```
01001111
```

could be interpreted as an ASCII character, as well as an 8-bit, signed decimal integer.

VF An operating system typically has one user space and multiple kernel spaces.

VF Version control systems (such as RCS and CVS) exist for systems such as UNIX, but they are unnecessary for the GUI-based development systems such as those found on MicroSoft Windows.

XT C has two parameter-passing modes, pass-by-value and pass-by-reference.

B. (1 mark each, 12 marks total)

Fill in the blanks in the statements below with the word or phrase which best fits.

1. The top-level directory in the UNIX file system is called the file system X .
2. Statically-allocated variables are stored in the stack X area of a process's data address space.
3. A component of an operating system called the kernel ✓ is typically responsible for interfacing to hardware, implementing the process abstraction, and coordinating processes of multiple users.
4. A ~~file~~ variable X is a named sequence of addressable, nonvolatile bytes. file
5. stderr ✓ is redirected in *bash* and *sh* by using the construction 2>*filename*
6. The file ./bash.rc X is the name of "configuration file" for *sh*, *bash*, and *ksh*. It contains commands which are executed upon startup by the shell program. .profile
7. A(n) absolute ✓ pathname begins with a "/".

8. Every open file is assignment a number called a _____ which is actually a small integer but which can be thought of as a "pointer to a file".

9. A _____ is a pair of streams, one for writing and one for reading, such that everything written on the output stream can be read from the input stream in order and with full fidelity.

10. A _____ character is used to prevent interpretation of a metacharacter in a regular expression or in a filename pattern.

11. In the representation schemes for signed numeric values covered in class, the _____ bit is taken as indicating the sign (+ or –) for the value.

12. In a _____ the name of a variable and its type is given, but no storage is allocated.

C. (3+4+3+1+1+2+1+1+3 = 19 marks)

Answer each of the following questions with a very short, precise answer.

1. If x is an int, what gets printed by the code fragment below?

```
x = 031;
printf( "%x\n", x );
```

2. Suppose you would like to invoke the *more* command on every file in your current working directory whose name starts with the letter "t" followed by at least one character, and ends with either ".bac" or ".bak". Give the filename pattern which will generate this set of files.

3. If i is an int and p is a pointer-to-int, what values get printed by the code fragment below?

```
i = 3;
p = & i;
printf( "%d %d ", *p+7, **&p );
printf( "%d\n", ++*p );
```

4. Suppose that the following code fragment

```
int i, *ip = &i;
printf( "%p\n", ip );
```

produces the output

```
0xbffffba0
```

It was stated in class that there are usually many relocation bases present (implicitly or explicitly) in a program. This holds for the address 0xbffffba0 above. Name a relocation base to which the address 0xbffffba0 is relative.

5. Consider the following program sample

```
int cbuf[100]= {0, 1, 2, 3, 4, 5, 6, 7};
...
printf( "%zu\n", sizeof( cbuf ) );
```

What will be printed, assuming int datatypes are 4 bytes?

6. Give the name of two editors which are available on the LINUX computers in the lab (the *morph* and *stealth* machines).

2 vi emacs

7. Give an example of a built-in command in *sh* or *bash*.

1 $SomeVaribe = SomeValue ; export SomVaribe)

8. One source of online documentation on the lab LINUX machines is the "man pages", the information given by the *man* command. There are GUI interfaces to the "man pages", including *xman* and *tkman*. What is another command available on the lab LINUX machines which provides online documentation? Note: the answer does not involve web pages or web browsers.

1 apropos

9. A user has a file named `temp` in her current working directory and issues the following command involving `temp`:

```
chmod 354 temp
```

If the user then issues a

```
ls -l
```

command, various information will be output, including the file permissions in symbolic form. What will those permissions be (given the earlier `chmod` command)? Make sure to give the permissions in symbolic form as would be output by the *ls* command?

1 X--------r-- temp -wxr-x-r--

In the case above, can the owner of the file read it? Yes or no?

NO

D. (6 marks)

2 Give a portion of C code which exemplifies the following functionality. Note, do not give a program, or even a complete function; just give a set of statements which achieve the specified functionality. Make sure to include the declaration of any variables you might need.

1. Define an array, `cbuf`, of 100 bytes as a statically allocated global array. Then, using an explicit type cast, assign the address of the array to a variable `iarr` local to function `main()` which is of type pointer-to-`int`. Finally, treat bytes 12, 13, 14, and 15 (indexing from 0) of `cbuf` as a data object of type `int` using `iarr` and increment the value of that data object by 2.

only 1 byte

char cbuf[100]; +1

void main()

{

int *iarr = &cbuf;

cbuf[11]=(int)**iarr[11]+2;

cbuf[12]=(int)*iarr[12]+2;

cbuf[13]= int ..... and so on;;

}

+1

(int*) cbuf

iarr[3] += 2

:

}

E. (5+4 = 9 marks)

Give a UNIX command which has each of the following functionalities. In each case the command may be a simple command or complex command, as necessary.

1. Suppose that a text file contains a list of numerical readings from a laboratory instrument, one reading per line. The file is called `readings.txt`. Assume the readings are all of the form zero or more digits, followed by a decimal point, optionally followed by zero or more digits. Further assume that there is no white space preceding the first digit of the value on each line.

   Write a command which will produce, on the standard output, the two largest values in the file. The two values can be on separate lines, or they can be on the same output line — the choice is yours.

   Hint: consider using the *sort*, *head*, and/or *tail* commands.

5 sort -n readings.txt | tail -2

2. Consider again the file of numerical readings in part 1 (above) of this question, `readings.txt`. The user would now like a command which will output, on the standard output, a count of the number of readings which are greater than or equal to 100, but less than 200. Give a UNIX command involving *grep* which will accomplish this.

1 grep [1...] readings.txt | wc -l

grep -c 1..1 readings.txt

F. (3+4+6+ = 13 marks)

Answer each of the following questions with a discussion-oriented answer. Feel free to use examples to illustrate your points.

1. One of the pieces of software on the computers in the lab (*morph* and *stealth* machines) is called X-Windows. What is X-Windows? What is it's functionality? What does it do?

X-Windows is a graphical environment +1 that KDE or Gnome uses. It allows the user to use the mouse to position windows on the display.

What else?

2

2. **What is the difference between the commands "`cvs commit`" and a "`cvs update`" in the context of CVS?**

CVS commit makes your changes to the repository, CVS update allows a user to see what changes they will be making relative to the current version in the repository

2 good. what else?

3. **A student wants a function which will create an array for her. She often needs character arrays of size 255, so she writes the following function:**

```
char * create_array( ) {
   char buf[255];

   return( buf );
}
```

She uses the function as follows

```
int main( int argc, char *argv[] ) {
  char *newbuf;

  ...
  newbuf = create_array();
  ...

}
```

Her program compiles, though against the advice of her professor she does not use the `-Wall` flag when compiling her program with *gcc*. When she runs her program it sometimes behaves strangely. For example, in some instances she copies characters into `newbuf` only to find later that the contents of the array have been inexplicably modified. Other times the program "crashes" with a "segmentation fault" error.

What has the student done incorrectly? Explain the nature of the error in terms of storage allocation and stack frames.

~~The pointers used are incorrect~~

The variables are ~~declared~~ out of scope +1 and thus cease to exist in the program, +1 As the program executes memory locations are allotted where? and changed then when she dereferences a pointer it gets the value of the address, not the initial value assigned? If ~~she does~~ she ~~requests~~ tries to write to an address of the stack that is read only she gets a segmentation fault.

???

2

Extra Space

(The space below is for answer previous questions or for rough work.)